10. Active Institutional Controls

10.1 INTRODUCTION

10.1.1 Regulatory Requirements Relevant to Institutional Controls at WIPP

In recognizing the many uncertainties inherent in the analyses for the containment criteria, as established in Subpart B of 40 CFR part 191, EPA developed assurance requirements to guarantee that the implementing agencies act cautiously and take steps to reduce such uncertainties. The following six assurance requirements are stipulated in §191.14:

- Active Institutional Controls
- Monitoring
- Passive Institutional Controls
- Barriers
- Resource Disincentives
- Waste Removal

Active institutional controls are defined in §191.12(f) as:

> "Active institutional controls means: (1) Controlling access to a disposal site by any means other than passive institutional controls; (2) performing maintenance operations or remedial actions at a site, (3) controlling or cleaning up releases from a site, or (4) monitoring parameters related to disposal system performance."

Active institutional controls operate sequentially in conjunction with passive institutional controls to protect and mark the WIPP site. Passive institutional controls are defined in §191.12(e) as:

> "Passive institutional controls means: (1) Permanent markers placed at a disposal site, (2) public records and archives, (3) government ownership and regulations regarding land or resource use, and (4) other methods of preserving knowledge about the location, design, and contents of a disposal system."

Active institutional controls are applied after “disposal,” (i.e., after all shafts to the repository are backfilled and sealed (§191.02(1)), when the waste has been permanently isolated with no intent of recovery. According to §191.14(a), "active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contributions from active institutional controls for more than 100 years after disposal." In Appendix C of 40 CFR part 191, guidance is provided for implementation of institutional controls that states "the implementing agency will assume that none of the active institutional controls prevent or reduce radionuclide releases for more than 100 years after disposal. However, the Federal Government is committed to retain ownership of all disposal sites for spent nuclear fuel and high-level and transuranic wastes and will establish appropriate markers and records, consistent with §191.14(c)."

Based on the active institutional controls requirement of 40 CFR part 191, EPA included the following compliance criterion under §194.41(a) of the 40 CFR part 194 regulations:

> "Any compliance application shall include detailed descriptions of proposed active institutional controls, the controls' location, and the period of time the controls are proposed to remain active. Assumptions pertaining to active institutional controls and their effectiveness in terms of preventing or reducing radionuclide releases shall be supported by such descriptions."

Examples of <u>active</u> institutional controls employed for the purpose of restricting site access include (EPA88):

- a [maintained] security fence and other barriers,
- security guards
- routine patrols
- electronic surveillance

Examples of <u>passive</u> institutional controls include signs, markers, deed restrictions, land-use controls, records, and legal documents. Passive institutional controls should warn those who attempt to enter the disposal site vicinity of the hazards associated with activities that would disturb the subsurface. Furthermore, passive institutional controls require comprehensive actions that will increase the likelihood that knowledge and information about the disposal site and its contents are passed on to future generations.

10.1.2 WIPP Site Characteristics

10.1.2.1 Site Description

The WIPP site is located in Eddy County, in southeastern New Mexico. The site is 26 miles east of Carlsbad on a relatively flat, sparsely inhabited plateau with little surface water and limited land uses. The land is primarily used for grazing. Other land uses within five miles of the WIPP boundary include potash mining and oil and gas exploration and development (SAN92).

The WIPP is a controlled site of 10,240 acres, which has been withdrawn from all forms of entry, appropriation, and disposal including, without limitation, mineral leasing laws, geothermal leasing laws, material sale laws, and mining laws as described in the WIPP LWA. Areas designated as subdivisions within the WIPP site boundary include Zones I and II. Zone I is an area of 35 acres surrounded by a chain link fence. Zone I encloses all the major surface facilities. Zone II overlies the maximum extent of underground development and encompasses an area of about 277 acres. The WIPP site boundary provides a minimum of a one-mile wide buffer area of intact salt beyond Zone II (DOE93).

10.1.2.2 WIPP Facilities

The WIPP site contains surface and underground facilities interconnected by four shafts. The surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of transuranic radioactive waste from the surface to the underground. The underground facility is constructed in a bedded salt formation 2,150 feet (655 m) below the surface. Existing underground facilities include the TRU waste disposal area, the experimental area, and the underground maintenance and support area (SAN92).

10.1.2.3 Waste Characteristics

DOE will use the WIPP to receive and dispose of TRU waste. TRU waste are those wastes containing radioactive elements with an atomic number greater than 92, a half-life greater than 20 years, and a concentration greater than 100 nanocuries per gram, excluding high-level waste and/other specific waste types. Some of these wastes are co-contaminated with hazardous constituents, making them mixed wastes. The wastes will be shipped in specially designed transportation containers and will be packaged in 55-gallon drums and/or standard waste boxes.

10.1.2.4 Operations

Following receipt and inspection, the waste containers, will be downloaded into the subsurface repository. Ultimately this repository will consist of eight “panels,” each of which will contain seven separate disposal “rooms” and interconnecting drifts. After an entire panel is filled, it may be closed to isolate it from the rest of the repository.

DOE expects that waste emplacement will begin in 1998 and continue for a 25-year period until the regulated capacity of the repository of 6,200,000 ft^3 of TRU waste has been reached. This capacity restriction must also include TRU waste derived from any decontamination activities during the disposal phase and decommissioning.

10.1.2.5 Closure/Post-Closure Activities

Current DOE plans indicate that prior to closing the waste disposal area, surface facilities will be decontaminated. Contaminated material that cannot be sufficiently cleaned to be released as uncontrolled material will be emplaced within the waste disposal area.

The final activities within the repository will be the closing of the waste disposal area and the sealing of the shafts. Upon completion of this activity, the remaining surface structures will be dismantled. All surface structures will be removed, except for the concrete Hot Cell structure and a sufficient quantity of salt tailings to support construction of the permanent marker berm. Disturbed land will be regraded and planted to return the site to as near its original condition as is practicable. At completion of the closure phase, DOE will implement the WIPP active institutional controls program.

10.2 ACTIVE INSTITUTIONAL CONTROLS PROPOSED FOR THE WIPP SITE

As part of the active institutional controls program, DOE has developed a set of design criteria that describe how the active institutional controls will be implemented. These criteria are summarized below:

- A fence line shall be established to control access to the repository's footprint area (the waste disposal area projected to the surface). A standard wire fence shall be erected along the perimeter of the repository surface footprint. The fence shall have gates placed approximately midway along each of the four sides.

- An unpaved roadway along the perimeter of the barbed wire fence shall be constructed to provide ready vehicle access to any point around the fenced perimeter, to facilitate inspection and maintenance of the fence line, and to permit visual observation of the repository footprint to the extent permitted by the lay of the land. This roadway shall connect to the paved south access road.

- To ensure visual notification, the fence line shall be posted with signs having, as a minimum, a legend reading "**Danger-Unauthorized Personnel Keep Out**" and a warning against entering the area without specific permission of DOE, or other local authority such as the Eddy County Sheriff's Office.[1]

- Contractual arrangements shall be developed to ensure that periodic inspections and necessary corrective maintenance are conducted on the fence line, its associated warning signs, and the roadway.

- Through direct DOE staffing support and/or contractual arrangements, procedures shall be established to provide routine periodic patrols and surveillance of the protected area by personnel trained in security, surveillance, and investigation.

- Processes will be developed for monitoring and controlling the long-term testing requirements of the permanent marker system.

- Processes will be developed for implementing the periodic monitoring requirements of the disposal system's monitoring program.

- Recommendations will be developed for modifications to the active institutional controls appropriate for access control and surveillance upon installation of the permanent marker system.

- Guidelines will be developed for recommending mitigation actions to be taken to address any abnormal conditions identified during periodic surveillance and inspections.

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[1] DOE is suggesting use of the Eddy County Sheriff's Department to conduct periodic surveillance of WIPP active institutional controls. This surveillance would be conducted pursuant to a contract between the DOE and the Sheriff's Department.

- Reports of activities associated with the post-disposal active access controls shall be prepared in accordance with regulatory requirements for submittal to the appropriate regulatory and legislative authorities.

Details on meeting these criteria were submitted as, "WIPP Active Access Controls After Disposal Design Concept Description." Summarized below are additional noteworthy items delineated in the report.

- <u>Access control</u>. Access to an area approximately 2,780 feet by 2,360 feet will be controlled by a 4 strand (3 barbed and 1 unbarbed in accordance with the Bureau of Land Management specifications) wire fence. A single gate will be placed approximately mid-way along each side of the fence for access. The western gate shall be 20 feet wide; and the remaining three gates shall each be 16 feet wide. Around the perimeter of the fence, an unpaved roadway 16 feet wide will be cut to allow for patrolling of the perimeter. Patrolling of the perimeter is based upon the need to ensure that no mining or well drilling activity is inadvertently initiated which could threaten the integrity of the repository.

- <u>Surveillance monitoring</u>. Surveillance monitoring will consist of drive-by patrolling around the fenced perimeter, two to three times per week. During the course of the patrol, particular note shall be taken of fence integrity, gate integrity, and locked conditions of each gate. Surveillance should also include visual observation of the entire enclosure area for any signs of human activity.
- <u>Maintenance and remedial actions</u>. Anticipated maintenance and remedial action issues during the active control period are minimal and should encompass issues such as fence/road maintenance, evidence of vandalism, potential erection of drilling equipment, grass fires, unauthorized entry in prohibited areas.

- <u>Control and cleanup of releases</u>. DOE intends to complete the decontamination process and disposal of derived radioactive waste prior to final closure of the waste disposal area and sealing of the shafts.

- <u>Long-term monitoring</u>. Details describing the establishment of a network of elevation benchmarks and the development of a data baseline from which to evaluate disposal system performance is described in the Long Term Monitoring Design Concept Description (DOE94). (NOTE: Disposal system <u>monitoring</u> is addressed in §191.14 as a separate assurance requirement; therefore this topic is discussed in detail in Chapter 11).

10.3 INSTITUTIONAL CONTROLS AT OTHER FACILITIES

For comparison, a review was conducted of active institutional controls proposed or implemented at other facilities and their corresponding regulations. (It should be noted that, although the focus of this chapter is active institutional controls, in practice and in the regulations there may not always be a clear delineation between active and passive controls.) DOE and Department of Defense (DOD) facilities that contain special nuclear material, NRC-licensed nuclear reactor facilities, low-level waste disposal facilities, uranium mill tailings disposal sites, and Superfund sites were examined. This review focused on those institutional controls specifically designed for protection against human intrusion because they have the most relevance to the WIPP.

10.3.1 Facilities Containing Special Nuclear Material

A number of DOE and DOD facilities must protect special nuclear material. The access controls at these facilities represent the extreme end of the controls continuum that could be considered for application at the WIPP. Typically, these controls include continuous monitoring by armed guards, double rows of chain link fence topped with barbed wire, motion detectors, infrared detectors, and visual surveillance using remote TV cameras. These controls are designed to prevent intentional intrusion into critical areas where the special nuclear material is stored, and to ensure the material is not stolen or sabotaged. These controls also prevent inadvertent intrusion. Many of the specific control elements in place at these facilities resemble the proposed controls for WIPP. For example, the fact that the TRU waste will be over 2,000 feet below the surface should be at least as effective a control as the fencing arrangement at DOE special nuclear facilities such as Pantex.

10.3.2 Retired Nuclear Reactor Facilities

When a nuclear reactor has reached the end of its useful life, it must be decommissioned in accordance with the requirements established in 10 CFR part 50. NRC regulations define "decommissioning" as the process of reducing residual radioactivity to a level that permits release of a facility for unrestricted use and termination of an NRC license. In effect, this definition means that, after the radioactivity exceeding NRC limits for unrestricted use has been removed, no further institutional or administrative controls are required.

Licensees may request and have been granted exemptions to the unrestricted use requirement. One interim decommissioning alternative that has been used by several retired facilities is termed safe storage (SAFSTOR). Safe storage is defined as those activities required to place and maintain a nuclear facility in such condition that future risk from the facility to public safety is within acceptable bounds and that the facility can be safely stored for as long as desired.

During the SAFSTOR period, irradiated fuel assemblies and in-core fission chambers are stored in the spent fuel pool. The onsite storage of spent fuel requires the continued operation of numerous plant systems, such as (1) service systems, (i.e., ventilation, spent fuel pool service, fire protection, and electrical), (2) waste disposal systems, and (3) monitoring systems, (i.e., stack gas radiation monitoring systems, process water monitoring, offsite environmental monitoring stations, etc.).

Active institutional controls at reactor facilities in a safe storage condition are extensive and are, therefore, not limited to protection against unauthorized entry. A permanent plant staff for the operation of necessary plant systems, preventative/corrective maintenance of structures, systems, components, and equipment, and onsite/offsite environmental monitoring must be maintained during the SAFSTOR period. During SAFSTOR, a licensee is required to maintain a full-time, onsite security force to prevent unauthorized access or deliberate intrusion into the facility. Additionally, a system of multiple locked physical barriers and warning signs/signals must be maintained to control access into areas where exposure to radiation is possible (NRC94).

10.3.3 Low-Level Radioactive Waste Disposal Facilities

The Nuclear Regulatory Commission established regulations under 10 CFR part 61 to cover all phases of land disposal of low-level radioactive waste (LLW). A LLW disposal facility licensed under 10 CFR part 61 consists of the land, buildings, and equipment required for the near-surface disposal of LLW. These regulations also require the use of a waste classification system, where high-activity Class C wastes are to be placed deep in the ground (at depths below 5 meters) or behind barriers to limit human intrusion.

Six commercially-operated LLW disposal facilities, located at Beatty, Nevada; Maxey Flats, Kentucky; West Valley, New York; Richland, Washington; Barnwell, South Carolina; and

Sheffield, Illinois, have been licensed and operated in the United States. These facility were licensed prior to the promulgation of 10 CFR part 61 and use shallow land burial designs. The Richland and Barnwell facilities continue to operate as disposal facilities for LLW, whereas the other four sites have closed.

Under the Low-Level Radioactive Waste Policy Act of 1980 and the Low-Level Radioactive Waste Policy Amendments Act of 1985, states are responsible for the disposal of commercial LLW generated within their respective boundaries. Since this legislative directive, several states and regional compacts are in various stages of planning and licensing new LLW disposal facilities. All new facilities will be licensed under 10 CFR part 61 or compatible Agreement State regulations. In addition, Envirocare of Utah, Inc., has applied to NRC for a license to construct and operate a facility to receive, store, and dispose of uranium and thorium byproduct material.

Institutional control requirements for LLW land disposal facilities, as cited in §61.59, specifically address control of access, environmental monitoring, surveillance, minor custodial care, and administration of funds to cover the costs for these controls. The primary institutional control to protection against inadvertent intrusion is physical security (e.g., barriers, fences) to limit site access. Other active controls include periodic inspection of the site, maintenance of disposal unit covers, revegetation of the disposal area, and maintenance of the security fence. For example, the site stabilization and closure plan for the LLW facility operated by U.S. Ecology Inc. in Richland, Washington, has proposed the following active institutional controls as part of their Site Stabilization and Closure Plan (USE95):

- At closure, security around the facility will be maintained by the existing 8 foot high galvanized chain-link fence, which is topped with three strands of barbed wire.[2]

- Two times each year, during the 5 to 54 year post-closure and maintenance period, a crew of two men and foreman will spend three days each visit performing miscellaneous maintenance.

- Annually, during the 55 to 100 year post-closure period, a crew of two men and a foreman will spend three days performing necessary maintenance. Also

[2] This fence is much more robust than that proposed for the WIPP site; however the waste at Richland is shallow lying and hence more prone to disturbance by surface activities.

during this period, the fence surrounding the facility will be replaced.

Although 10 CFR part 61 specifies that institutional controls cannot be relied upon for more than 100 years, some of the new LLW disposal facilities are proposing the use of active controls for longer than 100 years. For example, a minimum of 100 years of active controls is proposed for new facilities in California and Nebraska (KAR95); and the license application for a new facility in Illinois contained a 300-year active institutional control period (NRC93).

10.3.4 Uranium Mill Tailings Disposal

Uranium mill tailings are a byproduct waste that results from the processing of ore to extract uranium. Historically, uranium mill tailings have been stored in large surface impoundments. The principal health concern is exposure to radon-222, a radioactive decay product of uranium.

Long-term stabilization and disposal regulations were developed under the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) by EPA and NRC and set forth in 40 CFR part 192. In addition, the NRC developed specific licensing and design criteria, which are addressed in 10 CFR part 40, to implement EPA's environmental standards.

In accordance with existing regulations, uranium mill tailings must be stabilized for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years without active maintenance. Therefore, controls for stabilization and safe isolation of the tailings primarily rely on site characteristics and engineering designs.

Site closure activities, which are intended to reclaim and stabilize the site to such a degree that no active, ongoing maintenance is required, typically consist of the following:

- dewatering the tailings ponds,
- implementation of a ground water remediation program,
- filling the impoundment area with a sufficient quantity and type of material to reclaim and stabilize the site (reduce radon to acceptable levels) in an environmentally sound manner,
- dismantling, disposing, or salvaging mill site buildings and material,
- decontamination of mill site soils,

- establishment of an appropriate environmental monitoring program for closure and post-closure needs.

Institutional controls to protect against inadvertent intrusion are neither explicitly identified or designated in the regulations for surface remediation of tailings disposal sites, nor do they provide definitions of, or specific criteria that distinguish between, active and passive institutional controls. However, provisions in EPA standards and NRC regulations that contribute directly and indirectly to intruder prevention and protection include (1) transfer of ownership and control of the site, to a government agency (usually DOE) for long-term custody, records control, and deed and land-use restrictions; and (2) periodic site inspection and surveillance, monitoring, and, if necessary, maintenance during the post-closure period.

10.3.5 Superfund Sites

EPA is responsible for remediation of hazardous releases into the environment under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. This program, commonly referred to as the Superfund Program, involves the remediation of more than 1,400 contaminated sites. CERCLA requires that Superfund sites comply with the organizational structure, procedures, and criteria specified in the National Contingency Plan (NCP), 40 part CFR 300.

By the end of 1993, Superfund remedial actions at 21 radioactively contaminated sites had been determined. Institutional controls were included as part of the selected remedies for 12 of these sites. However, the institutional controls at eight sites were only selected for an interim period until the final remedy was implemented, which required development of offsite waste disposal capacity.

Institutional controls selected to support temporary remedies include access control, fencing, waste storage, surveillance, and monitoring. For three sites with permanent remedies, institutional controls included access controls (typically fences), deed restrictions, leachate collection and treatment, groundwater monitoring, drilling and pumping restriction, cover maintenance, and procedural controls. For example, at the Maxey Flats low-level waste disposal facility in Kentucky, EPA's final remedial action includes institutional controls to restrict use of the site and to ensure monitoring and maintenance of the site in perpetuity, since the radioactive and hazardous waste, once stabilized, will remain onsite.

In terms of institutional controls, the NCP is sufficiently general to allow the use of a wide range of institutional controls, if necessary, to protect human health and the environment. Detailed selection of institutional controls occurs as a part of the remedial design, after the selection of the remedy in the Superfund Record of Decision. EPA or the state agency negotiates the type and necessary duration of the institutional controls with responsible parties and affected interests. Since the majority of selected remedies to date ultimately require the removal of radioactively contaminated materials, the use of institutional controls are typically passive, such as deed restrictions and ordinances to limit access or resource use.

10.3.6 Applicability to WIPP

Institutional controls defined by Federal regulations at various other facilities are primarily affected by post-closure conditions and characteristics and accessibility of the hazardous materials. As discussed above, active institutional controls for restricting site access can range from a combination of full-time security guards, visual and electronic surveillance, and multiple locked barriers at facilities in SAFSTOR to facilities, such as uranium mill tailings disposal sites, where the closure goal is intended to reduce the necessity for and reliance on active institutional controls.

Due to profound differences in siting, waste characteristics and form, accessibility of emplaced hazardous materials, and post-closure conditions between WIPP and the above-cited facilities, the active institutional controls employed at these sites are not directly applicable. However, the range of active institutional controls at these sites can serve as a basis for establishing bounding criteria for the controls required by 40 CFR part 194. It should be noted that no nuclear facility subject to active institutional controls has been in existence for more than about half the 100-year post-closure period allowed for active institutional control credit in 40 CFR part 194, thus limiting the experience available to determine the adequacy of these safeguards. One can cite other governmental institutions where active institutional controls have been in place for more than 100 years (e.g., Sing Sing Prison), but the applicability of such experience to a geologic repository is questionable.

10.4 ADEQUACY OF PROPOSED ACTIVE INSTITUTIONAL CONTROLS FOR WIPP

As previously defined, active institutional controls refer to the deliberate actions taken to restrict access to and use of the site.

The primary considerations in waste disposal siting strategies and design features are their effectiveness in isolating the waste and protecting against inadvertent intrusion into the disposal area. Siting features include selecting a location where the benefits of the site outweigh the detriments. Detriments could be concerns that population growth could affect the site or that future exploration for natural resources (e.g. hydrocarbons, minerals, water) could effect repository performance. Design features consist of using natural and engineered barriers to isolate the waste and minimize/mitigate the effects of human intrusion.

Massive geologic formations between the waste and the earth's surface are undoubtedly the primary design feature that limits inadvertent intrusion to buried waste. Perimeter fences, barriers, warning signs, and controlled use of access roads provide a second level of control measures to protect against inadvertent intrusions. A third level involves surveillance. Surveillance may be continuous or periodic, conducted through visual inspection by security personnel, and supplemented by electronic devices.

The adequacy of institutional control measures must, therefore, be assessed in terms of the effectiveness by which control measures limit intrusions. The effectiveness of institutional controls can be assessed for a number of intrusion scenarios; however, the active institutional controls being considered for the WIPP consider drilling as the only intrusion scenario that could credibly breach the repository. The section that follows describes alternate intrusion scenarios, and examines them with respect to: 1) probability of occurrence, 2) consequences, and 3) effect of additional active institutional controls on the probability of their occurrence.

10.4.1 Inadvertent Intrusion Scenarios

An intruder may encounter a closed waste disposal site and, due to a temporary or permanent breakdown in institutional controls, engage in a variety of activities. Such unintentional intrusions may be transient, short-term, or even permanent (NRC84). Potential intrusion scenarios, their likelihood of occurrence, and potential radiological consequences are discussed below.

10.4.1.1 Recreational

This scenario encompasses numerous plausible activities involving trespassing of hikers, campers, off-road vehicle operators, etc.

- Probability of Occurrence - A perimeter fence and warning signs and periodic security inspections that verify their integrity minimize the possibility of inadvertent intrusion. Under unusual conditions in which fence and warning signs are removed but security inspections are maintained, such intrusions would be limited to less than a four-day time period.

- Potential Consequence - The pre-closure decontamination and removal of surface structures and restoration of land to pre-operational conditions would ensure that exposure from contact with existing surface materials, including soil, is below regulatory limits. Thus, for recreational intrusions that do not significantly modify the site and are of short duration, potential radiological consequences are insignificant.

10.4.1.2 Agricultural

In this scenario, the inadvertent intruder is assumed to plant crops on the disposal site for human or farm-animal consumption.

- Probability of Occurrence - The aforementioned institutional controls at WIPP, which include construction and maintenance of a perimeter fence, warning signs, and periodic security inspections, preclude the likelihood of the intruder-agriculture-scenario. Even the transient loss of these institutional controls for a period of days to weeks is insufficient to support a growing period of weeks to months required for agricultural crops.

  A significant factor in this scenario is that site characteristics, defined by soil quality and rainfall, would not support agricultural activities. Thus, the probability of occurrence for this scenario is insignificant during the period for which active controls will be in place.

- Potential Consequence - Although crops cannot be affected by waste disposed at a depth of more than 2,000 feet below the surface, garden crops and animal forage become contaminated from radioactivity contained in soil as a result of root uptake and foliar deposition of resuspended soil particles.

  The level of residual soil contamination at the WIPP following closure can be assumed to comply with current standards that limit soil contamination within the root zone to 5 pCi/g and to 15 pCi/g below the root zone. These values are likely to represent bounding values for the agricultural intruder scenario and would cause only minimal impact with regard to human exposure.

10.4.1.3 Home Construction

This scenario assumes that an intruder inadvertently proceeds with construction of a home on the disposal site. Construction includes excavation for concrete footers, basement, utilities, etc. These typical activities should not be expected to involve depths in excess of 15 feet. One noteworthy exception, however, is drilling for well water, which is discussed separately below.

- <u>Probability of Occurrence</u> - Full implementation of proposed institutional controls renders this scenario highly improbable. Only with an extended breakdown in active institutional controls is it conceivable that construction could inadvertently progress through the initial phase of home construction that includes excavation of a basement, septic system, and grading of the construction site.

- <u>Potential Consequences</u> - Disturbance of site surface layers that are assumed not to exceed 15 pCi/g would expose construction workers to low-level airborne environments and external radiation during this brief period of construction. Intruder exposure from these pathways is very low.

10.4.1.4 Groundwater Scenario

There are several potential groundwater scenarios depending upon the intended use of the site. A well may be drilled on behalf of the agricultural intruder scenario, the home-construction intruder scenario, or for cattle grazing on the open range.

- <u>Probability of Occurrence</u> - Drilling for water can be expected to occur only if there is a prolonged breakdown of institutional controls. The concern for well drilling and mining at the WIPP can be addressed by considering that, using current drilling technology, it typically requires at least 2-3 days for a driller to setup a deep drilling rig and commence actual drilling operations. To attain the 655 meter depth that would approach the repository horizon takes at least another week to 10 days. Patrolling the fenced area 2-3 times weekly would identify potential drilling activity well before any breach of the repository could occur.

  Active wells exist in the Dewey Lake Red Beds 3.2 to 3.4 miles south of the repository (about 1.2 miles south of the southern boundary of the Land Withdrawal Area) (DOE93a).

Beyond these temporal limitations, the improbability of drilling for water is more likely to be due to common knowledge among local well drillers that there are no known potable aquifers in the immediate vicinity of WIPP.

- Potential Consequences - Deep well drilling could bring water from the Culebra Member of the Rustler Formation to the surface. The water may be contaminated and contain radiologically significant quantities of waste only if the water well drilling activity has been preceded by an intrusion into the repository.

According to DOE, "water quality of the Culebra in the vicinity of the WIPP is naturally poor and the waters are not usable for human consumption or for agricultural purposes," (DOE93a).

10.4.1.5 Drilling for Hydrocarbons

Exploratory drilling for oil and gas is a common activity around the WIPP site. As domestic and world oil and gas supplies dwindle over the next 100 years, the incentive for exploratory drilling may escalate.

- Probability of Occurrence - As discussed with respect to the water drilling scenario above, when proposed institutional controls are maintained, the likelihood of inadvertent commercial drilling for hydrocarbons must be considered highly improbable. Only with prolonged or sustained breaks in institutional controls (i.e., greater than 3-4 weeks) could this scenario progress sufficiently far to pose a radiological threat. Assuming that "rank wildcat" exploration is carried out at a rate of about 3×10^{-4} drill holes per square kilometer per year (TRA91),[3] for the 277-acre fenced area at WIPP, this would imply a probability of 6×10^{-2} that a single bore hole would be drilled inadvertently into the repository over a 100-year period. This probability is based on a sustained breakdown of institutional controls for the entire 100-year period.

- Potential Consequence - Potential radiological consequences resulting from exploratory drilling for hydrocarbons are greater than those previously identified in the water drilling scenario because the deeper hydrocarbon boreholes are more likely to intercept the buried waste.

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[3] SAN92 states that, based on guidance in Appendix B of the Standard, "a maximum of 30 boreholes/km ^{2} were allowed in 10,000 years."

10.4.2 <u>Intentional Intrusion Scenarios</u>

In this chapter <u>intentional</u> intrusions scenarios refer to activities associated with individuals who willfully and knowingly violate institutional control efforts. Intentional intrusion scenarios can be further categorized as benign and hostile.

10.4.2.1 Benign Intentional Intrusion Scenarios

There are numerous scenarios that can be labeled as benign intentional intrusion. The activities associated with benign intrusions generally do not go beyond willful trespass and, therefore, do not pose a radiological threat. Intruders in this category are likely to include tourists, curiosity seekers, souvenir collectors, people intent on mischief/vandalism, etc.

- <u>Probability of Occurrence</u>. Population expansions and encroachment by future communities at the WIPP site will undoubtedly raise the probability and frequencies of these intrusions so as to make them commonplace. A sincere desire to impede this type of willful intrusion would require that the proposed 4-strand wire fence be replaced by a more effective fence (e.g., operating nuclear power plants employ an eight-foot typhoon fence topped with several coils of razor wire for primary perimeter protection).

- <u>Potential Consequence</u> - In general, benign willful intrusions are likely to have no radiological significance. Of potential consequence might be a scenario in which a souvenir hunter by means of a metal detector finds an accessible contaminated metal object that had failed detection during pre-closure cleanup efforts.

10.4.2.2 Hostile Intentional Intrusion Scenarios

This classification of intrusion is defined by activities aimed at accessing disposed waste for purposes of sabotage and/or terrorism. Although the waste is protected by more than 2,000 feet of overlying geological formation consisting of soil, sand, rock, and salt, only drilling equipment (as used in drilling water, gas, or oil wells) is needed to penetrate the repository horizon. Acts of sabotage or terrorism may involve the introduction of chemical and physical agents, inclusive of explosives, that would impact containment integrity of stored waste and possibly result in the immediate release of radioactivity to the surface, as well as long-term releases to geologic formations surrounding the breached waste.

- <u>Probability of Occurrence</u> - The <u>inadvertent intrusion</u> scenarios involving drilling for water and hydrocarbons, state that drilling activities are likely to require a period of up to two weeks before the well depth reaches that of the buried TRU waste.

  An act of sabotage or terrorism is technically feasible, but may be logistically impossible.

  Since historical acts of sabotage and terrorism have been few and sporadic and may be motivated by political, social, and other factors, a quantitative estimate of probability is inappropriate.

- <u>Potential Consequence</u> - The radiological consequences of an act of sabotage or terrorism is dependent on the methods employed for accessing the repository and damaging contained waste. However, any successful act may pose a potentially severe immediate and long-term radiological threat.

10.5 REFERENCES

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